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(54) **Control apparatus for an embroidering machine.**

(57) An embroidering machine comprises a plurality of needles 11, each mounted on a needle bar 8 and drivable by a driving bar 42. When patterns are to be embroidered in a workpiece it is necessary for certain needles to be temporarily non-operative. Conventionally this has been done by means of a control shaft provided with appropriate projections and concavities. The conventional arrangement has not been found to be sufficiently flexible and so the invention provides a plurality of solenoids 23 which act through the agency of various connecting levers and members to render the needles temporarily non-operative.

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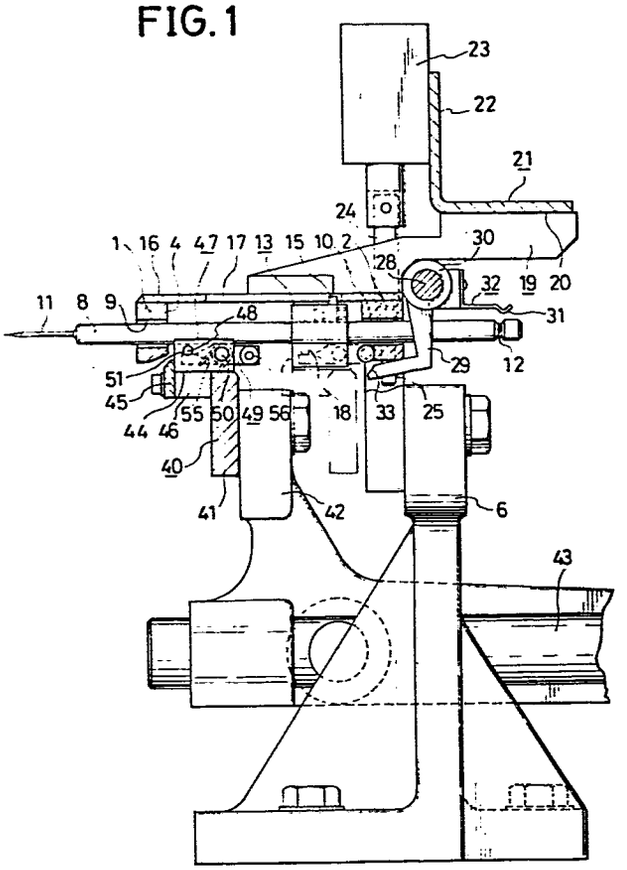
FIG. 1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CONTROL APPARATUS FOR AN EMBROIDERING MACHINE

The present invention relates to a holding apparatus for needle bars of a braiding machine which are not operating.

Conventional apparatus of this type has been constructed so that projections and concavities are prepared on an outer drum surface of the control shaft. A needle bar is held in the non-operative position by releasable engagement of a pawl used to drive the needle bar. The conventional machine has the drawbacks that the control shaft has to cover the entire lateral extent of the embroidery length; assembly has to be sufficiently accurate; the joint portion, among other things, has to be sufficiently strong; and sophisticated holding and operating mechanisms are required for the smooth operation of the control shaft.

Bearing in mind the above disadvantage of conventional machines, the present invention aims to offer an apparatus for holding non-operating needle bars of a braiding machine by means of a solenoid which is simply and reliably operable. The need for a control shaft and a rotating mechanism is eliminated.

Conventional apparatus for holding non-operating needle bars uses punched holes in card to convert a mechanical signal to an electrical signal to hold the non-operating position. The control shaft is indexed by reducing its speed. The present invention allows the rate of rotation of the embroidering machine to be kept accurately, without reducing the speed, by employing solenoids.

Conventional control mechanisms are generally constructed with projections and concavities on an outer drum surface of a control shaft. The permutations and combinations of the various non-operative needle bars are determined by the arrangement of the projections and concavities. Each time the permutation is to be changed, the arrangement of the projections and concavities of the control shaft itself must be changed. Because of mechanical and spatial limitations it is difficult to prepare as many different arrangements of the projections and concavities as are needed for the various combinations of non-operative needle bars. However, the present invention allows the positions of the non-operating needle bars to be determined for the total extent of a broad embroidering workpiece.

This may be done by storing the order in which needle bars are to be held non-operating in the memory of an electronic control apparatus. Irregular designs and patterns may also be embroidered. Further, a large pattern can be embroidered within longitudinal and latitudinal extents of the equipment without unused needles having to be removed as has been required with conventional machines.

In a conventional control shaft system, for some embroidery patterns, the projections and concavities on the outer drum surface of the control shaft are generally arranged to select successive non-operating positions alternatively as in the case of:

(1) holding all the needle bars across the breadth of the workpiece in the non-operating position;

(2) holding neighbouring pairs of needle bars in the non-operating position; and similarly

(3) holding groups of three, four or more needle bars in the non-operating position.

In order to hold some needle bars in the non-operating position the control shaft had to be rotated in a positive or negative sense. However, by the present invention, which uses solenoid, the non-operating positions can successively be held simply and quickly by storing the positions in a memory of electronic control equipment.

The present invention can, in cartain embodiments, include a needle bar suspension mechanism. This can hold needle bars in the non-operating position for an interim without solenoid action, but just as if the solenoid was operated. This enables the needle bars of cut yarn only to be stopped without stopping the whole machine. Thus the operation rate of the machine can be raised.

The present invention provides a new control apparatus for an embroidering machine, in which machine a plurality of needles is caused to act on a workpiece by driving means,

According to the invention, the apparatus comprises a plurality of solenoids, one for each of the needles, each solenoid being operable to prevent its respective needle being driven by the driving means.

Preferably, activation of each solenoid causes engagement means to engage with a support of the respective needle at a point in the needle's operating cycle at which it is withdrawn from the workpiece.

The driving means may comprise a push member adapted to bear on a surface of a respective needle support, when the needle is to be driven, thereby to drive the needle.

In a preferred embodiment, the respective solenoid is activatable to cause the push member to move so that it cannot bear on the said surface of the needle support to drive the needle. Such movement may be facilitated if the push member comprises a roller and is caused to move by the action of a chamfered arm on the roller. The push member may be so movable, preferably pivotally, against the action of a spring.

The portion of the push member adapted to bear on the said surface may be formed as a ratchet tooth so that the push member can only push in one direction.

The apparatus may further comprise data storage

means for storing data representative of the arrangement of operating and non-operating needles in sequential cycles of the machine.

For a better understanding of the present invention, and to show how it may be put into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a partially cut side view of an apparatus according to the invention;

Figure 2 is a partially cut plan view;

Figure 3 is a partially cut rear elevation;

Figure 4(A) is a side view showing a non-operating needle bar;

Figure 4(B) is a side view showing an operating needle bar;

Figure 5(A) is a part-schematic perspective view of the apparatus in a non-operating position;

Figure 5(B) corresponds to Figure 5(A) but shows an interim operating position; and

Figure 5(C) also corresponds to Figure 5(A) but shows the most advanced position.

Referring now to the drawings, an apparatus in accordance with the invention comprises a supporting stand 4. Projections 5 (see Figure 3) extend under both sides of the supporting table 4 and each is supported by a respective leg 6. The supporting table 4 is of a flanged I-section formed by a short front wall 1 and a long rear wall 2 which are connected by a plate 3. Several long guide holes 7 are formed in the top of the plate 3 and extend between the front and rear walls 1 and 2. Front and rear needle bar holes 9 and 10 are formed in the front and rear walls 1 and 2 respectively on an extension of the centre line of each long guide hole 7. Needle bars 8 can be inserted in the holes 9 and 10. A needle 11 is attached to the end point of each needle bar 8, and an engaging groove 12 is formed on each needle bar 8 at its rear end.

A moving block 13 is provided at the centre portion of each needle bar 8 and is fixed by two screws 14 on the upper side. An arresting pin 15 projects at the rear of the upper face of the moving block 13 to stop rotation of the needle bar 8. The arresting pin 15 is inserted into a groove 17 in a stop board 16 fixed to an upper face of the supporting stand 4.

The width of the under surface of the moving block 13 is smaller than that of the top, as shown in Figure 3. A stopper 18 is fixed on the side face of the block 13 towards the front end. The rear-side of the stopper 18 has a vertical face 18' (see Figures 4(A) and 4(B)).

Brackets 19 are fixed to both ends of the surface of the stop board 16; the back portion 20 of each bracket is towards the rear side of the stop board 16. On the upper face of each back portion 20 an L-shaped solenoid supporting plate 21 is fixed. A plurality of solenoids 23, each corresponding to a needle bar 8, is vertically fixed to a vertical part 22 of the solenoid supporting plate 21. An operating bar 24 of each solenoid 23 passes downwardly through the stop board 16 and rear wall 2 of the supporting stand 4, and a notched portion 25 is provided at the lower end of the bar as shown in Figure 5. In the upper part of the rear wall 2 where each operating bar 24 is located, a notched hole 26 is formed to expose the lower end of the operating bar 24 as can be seen from Figure 3.

A plurality of bearings 27 is fixed at a a certain spacing apart on the upper surface of the rear of the stop board 16 so that they project outwardly, and a single supporting shaft 28 is inserted through the bearings 27. The bearings 27 engage the upper end of respective L-shaped operating levers 29, so that they can rotate freely. A resilient needle bar stopper plate 32, having an engaging part 31 which fits into the engaging groove 12 of a corresponding needle bar 8 is fixed to collar 30 at the upper end of the operating lever 29. The free end of the operating lever 29 fits into the notched portion 25 of the operating bar 24; and the front of the free end of the operating bar has an upwardly inclined surface 33.

A spacer 34 lies between adjacent levers 29.

A driving arm 42 is fixed to both ends of a vertical wall 41 of a driving bar 40, which is of inverted L-shaped section. A driving shaft 43 is connected to the driving arm 42 to cause the driving bar 40 to reciprocate at right angles to its length. To the front of a horizontal wall 44 of the driving bar 40, a locating plate 45 is fixed so that its upper end projects. A plurality of operation holes 46 are provided, each a respective needle bar 8 in the horizontal wall 44. The holes 46 lie between locating plate 45 and the vertical wall 41. A plurality of fittings 47, each corresponding to an operation hole 46, is fixed to the horizontal wall 44. From each fitting 47, a location pin 48 projects horizontally at the front and to one side. An engaging lever 49 is pivotally mounted for rotation on each fitting 47 by means of a pin 50. The upper surface of the front portion of the engaging lever 49 is stepped to form a location surface 51. Just behind the locating surface 51 and to the opposite side of the engaging lever 49 from the fitting 47 a pressing member 52 is mounted(refer to Figure 5). The front side of the pressing member 52 served as a pressure surface 53. The back side of the pressing member 52 is inclined and serves as a relief surface 54. Thus the pressing member 52 is formed as a ratchet tooth. A coil spring 55 coils around the pin 50. One end of the coil spring 55 engages the bottom surface of the engaging lever 49. The other end of the coil spring 55 is inserted into the

operation hole 46 of the driving bar 40 to press the connection lever 49 upwards, thereby causing the locating surface 51 to engage the location pin 48. The rear end of the engaging lever 49 projects out from the driving bar 40. On the rear end, a roller 56, which engages the inclined surface 33 of the operating lever 29, is mounted for rotation.

The operation of the illustrated embodiment will be described now that its construction has been explained. When the needle bar 8 is operative, the solenoid 23 does not operate and the operation lever 29 is positioned so that its front end side is in the lower position as shown in Figure 1 and Figure 4 (B). When the driving bar 40 is positioned to the rear as shown in Figure 5 (B) and in solid lines in Figure 4 (B), the engaging lever 49 is pushed upwards by the coil spring 55, and the locating surface 51 bears against the lower surface of the location pin 48, and is horizontal. The pressure surface 53 of the pressing member 52 of the engaging lever 49 bears on the vertical surface 18' of the stopper 18 on the moving block 13 which is fixed to the needle bar 8. In this way, the engaging lever 49 connects with the moving block 13. Therefore, when the driving bar 40 advances as shown by the chain line position of Figure 4(B) and Figure 5 (C), the needle bar 8 moves forward with the moving block 13. When the driving bar is drawn back, the moving block 13 is drawn back simultaneously because the locating plate 45 fixed to the driving bar 40 bears on the front face of the moving block 13, and the needle

bar 8 is brought back. The advancement and retirement of the needle bar 8 effect the embroidering.

In case of fixing a particular needle 11, the solenoid 23 is operated to attract the operation bar 24. This causes the operating lever 29 to rotate about the supporting shaft 28 and the end of the operating lever consequently rises, as shown in Figure 4(A) and Figure 5 (A). The rotation of the operation lever causes the needle bar stopper 32 to descend and the engaging part 31 becomes located in the engaging groove 12 of the needle bar 8. In this way, movement of the needle bar 8 is prevented. The inclined surface 33 at the end of the operation lever 29 causes the roller 56 of the engaging lever 49 to move upwards. This causes the engaging lever 49 to rotate about the pin 50 and the end point inclines downwards. Because of this downward inclination of the end point, the pressure surface 53 of the pressing member 52 moves off the stopper 18 of the moving block 13. When the driving band 40 now advances, the roller 56 moves along the inclined surface 33 of the operating lever 29, and the engaging lever 49 moves at an inclination to the horizontal. But the engaging lever 49 becomes horizontal by the action of the coil spring 55 when the pressing member 52 has passed the position of the stopper 18 and the roller 56 has left the inclined surface 33. Therefore, only the engaging lever 49 advances, whereas the moving block 13 stays in its original position.

When the engaging lever retires, the roller 56 reaches the inclined surface 33 of the operating lever 29.

Then the relief surface 54 of the pressing member 52 contacts the stopper 18. After this the roller 56 rises up along the inclined surface 33, thereby causing the engaging lever 49 to pivot, and moves in a manner determined by the arcuate surface of the stopper 18 because of the inclination of the relief surface 54. Thus the engaging lever returns to its original position.

Therefore the needle bar 8 is not moved in spite of the reciprocating movement of the driving bar 40.

When a particular needle bar 8 is to stay immobile during the operation of the needle bars 8 in general, by operating the solenoid corresponding to the particular needle bar 8, the operating lever 29 moves to the position as shown in Figure 4 (A) and Figure 5 (A) as stated above. Therefore, the needle bar 8 continues to move with the movement of the driving bar 40 during its current operating cycle and the engaging lever 49 inclines at the end of the cycle as stated. Then the engaging part 31 of the needle bar stopper 32 becomes located in the engaging channel 12 of the needle bar 8 when the needle bar 8 is fully withdrawn. Thus the needle bar 8 becomes immobilised.

The L-shaped solenoid supporting plate 21 is fixed above the back portions 20 of the brackets 19. The solenoid 23 is fixed in a vertical position to this solenoid supporting plate 21. However, the position of the solenoid is not necessarily limited to that disclosed in this exemplary embodiment. For example, the solenoid 23 may be mounted parallel to and behind the needle bar 8, or indeed at any place which enables it to cause the respective operating lever 29 to rotate.

CLAIMS

1. Control apparatus for an embroidering machine, in which machine a plurality of needles (11) is caused to act on a workpiece by driving means (40,42), the apparatus being characterised in that it comprises a plurality of solenoids (23), one for each of the needles, each solenoid being operable to prevent its respective needle being driven by the driving means.

2. Control apparatus as claimed in Claim 1, characterised in that activation of each solenoid causes engagement means (32) to engage with a support (8) of the respective needle at a point in the needle's operating cycle at which it is withdrawn from the workpiece.

3. Control apparatus as claimed in Claim 1 or 2, characterised in that the driving means comprises a push member (52) adapted to bear on a surface (18^1) of a respective needle (8), when the needle is to be driven, thereby to drive the needle.

4. Control apparatus as claimed in Claim 3, characterised in that the respective solenoid is activatable to cause the push member to move so that it cannot bear on the said surface of the needle support to drive the needle.

5. Control apparatus as claimed in Claim 4, characterised in that the push member comprises a roller (56) and is caused to move by the action of a chamfered arm (29) on the roller.

6, Control apparatus as claimed in Claim 4 or 5, characterised in that the push member is so movable against the action of a spring (55).

7. Control apparatus as claimed in any one of Claims 3 to 6, characterised in that the portion of the push member adapted to bear on the said surface is formed as a ratchet tooth.

8. Control apparatus as claimed in any one of Claims 1 to 7, the apparatus being chracterised by comprising data storage means for storing data representative of the arrangement of operating and non-operating needles in sequential cycles of the machine.

9. Control apparatus as claimed in any one of Claims 1 to 8, characterised by comprising means for keeping at least one of the needles inoperative for a period ot time greater than one operating cycle of the machine.

10. An apparatus for holding unoperating needle bars (8) of an embroidering machine, comprising a supporting stand (4) to which a plurality of needle bars, each provided with a needle (11) at an end point, are supported so that the needle bars can reciprocate, a moving block (13) from which projects a stopper (18) at right angles with the direction of motion, and which is fixed to each of the needle bars, a driving band (40) which is provided with a locating plate (45) which locates the front face of the moving

block, and reciprocates a plurality, the same numebr as that of the needle bars, of approximately L-shaped operation levers (29) each having an inclined surface on the upper face of its front end being supported on the supporting stand so as to be free to rotate, a plurality of solenoids (23) each having an operation bar (24) to rotate each operation lever, and a plurality of engagement levers (49) each of which has a roller (56) at its rear end to engage the inclined surface and a pressure surface (53) on a horizontal projection, disposed at its front end to engage with the rear side of the stopper and attached to the driving band, the engagement lever being pushed upwardly by a coil spring (55).

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FIG. 1

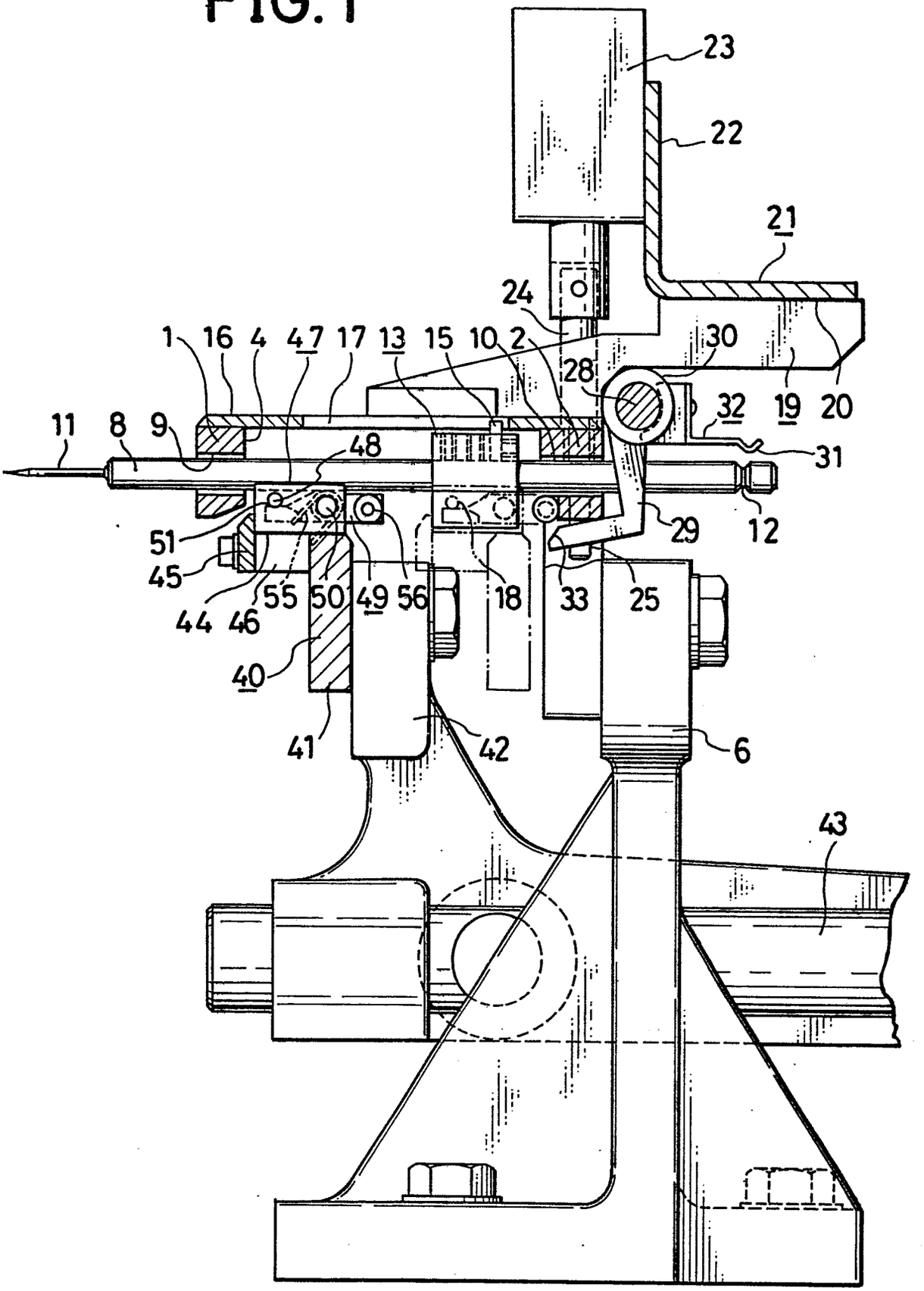

FIG.2

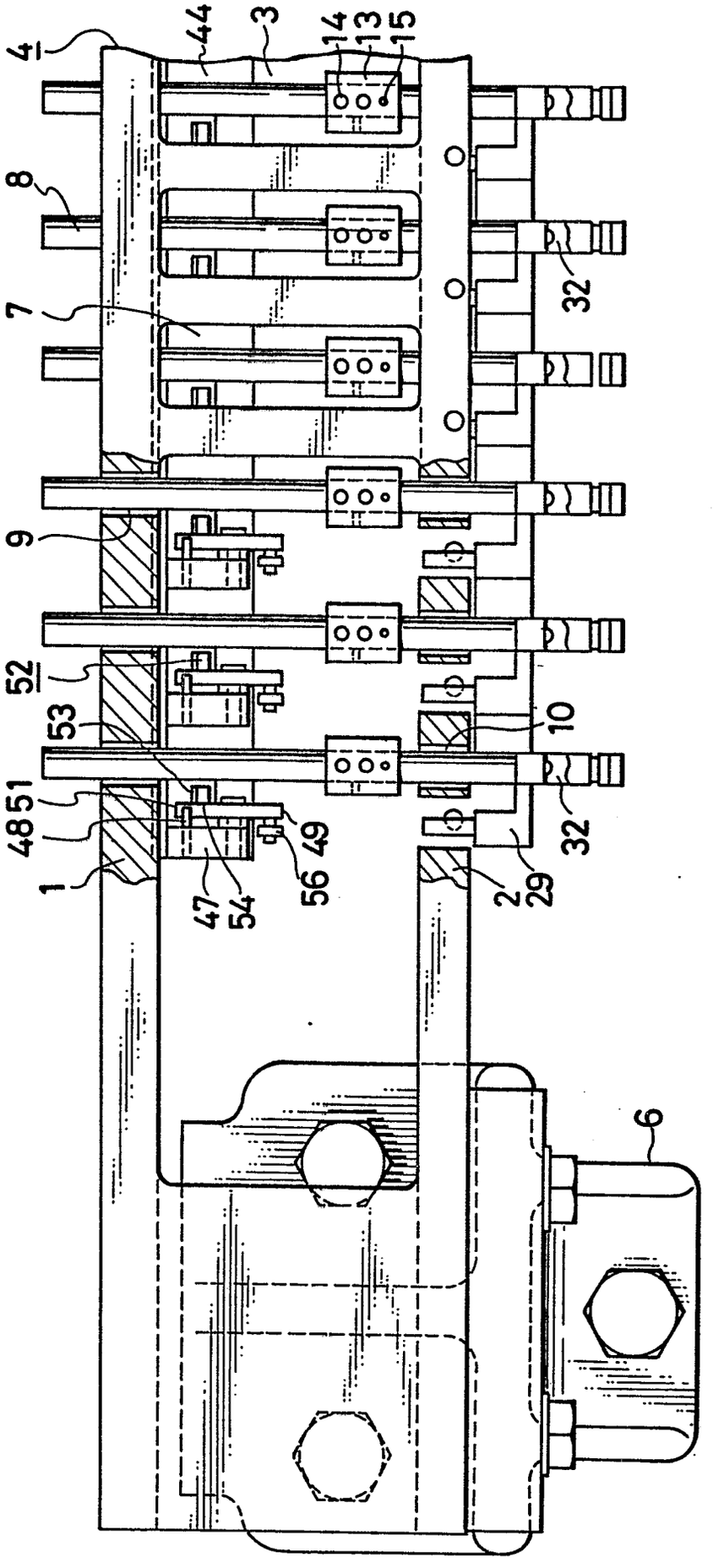

FIG.3

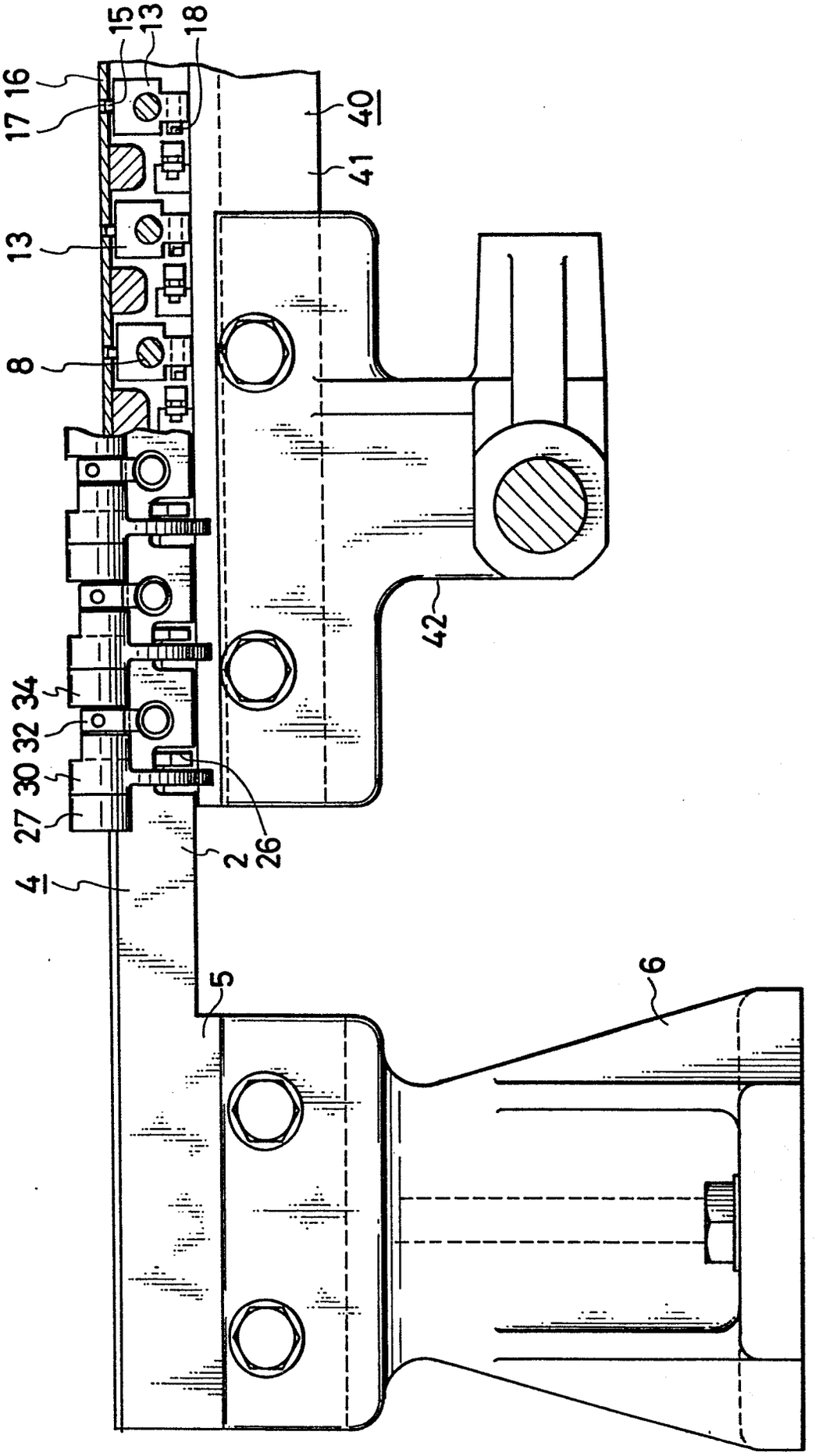

FIG.4 (A)

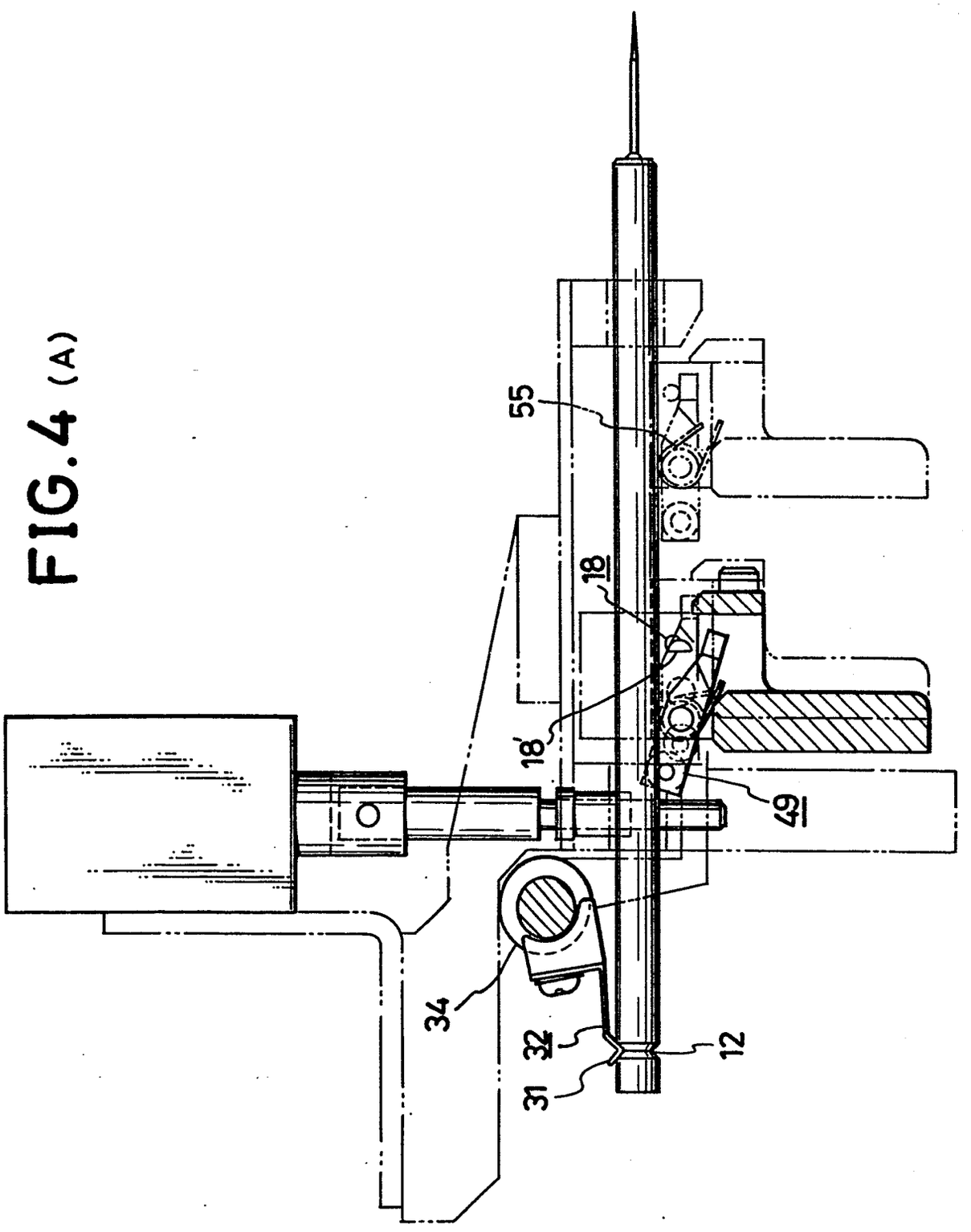

FIG.4 (B)

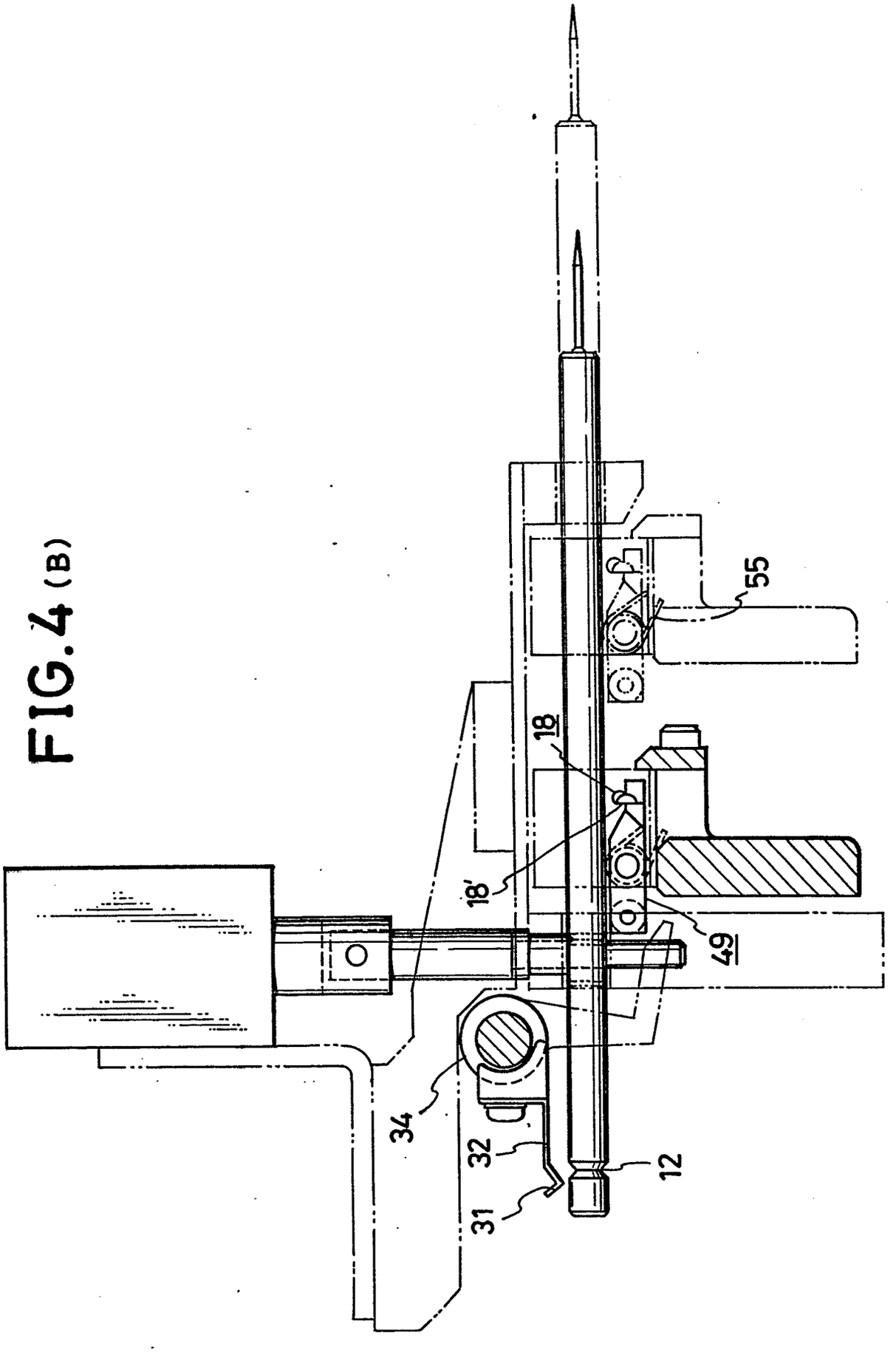

FIG.5

(A)

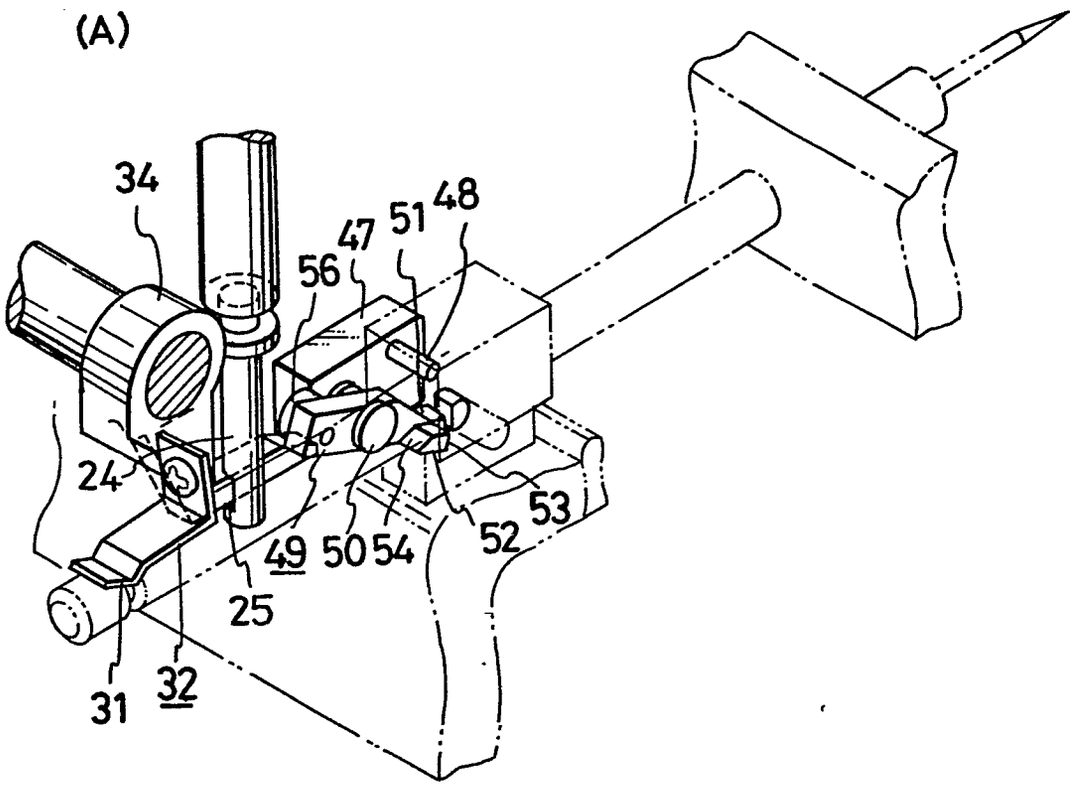
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FIG.5

(B)

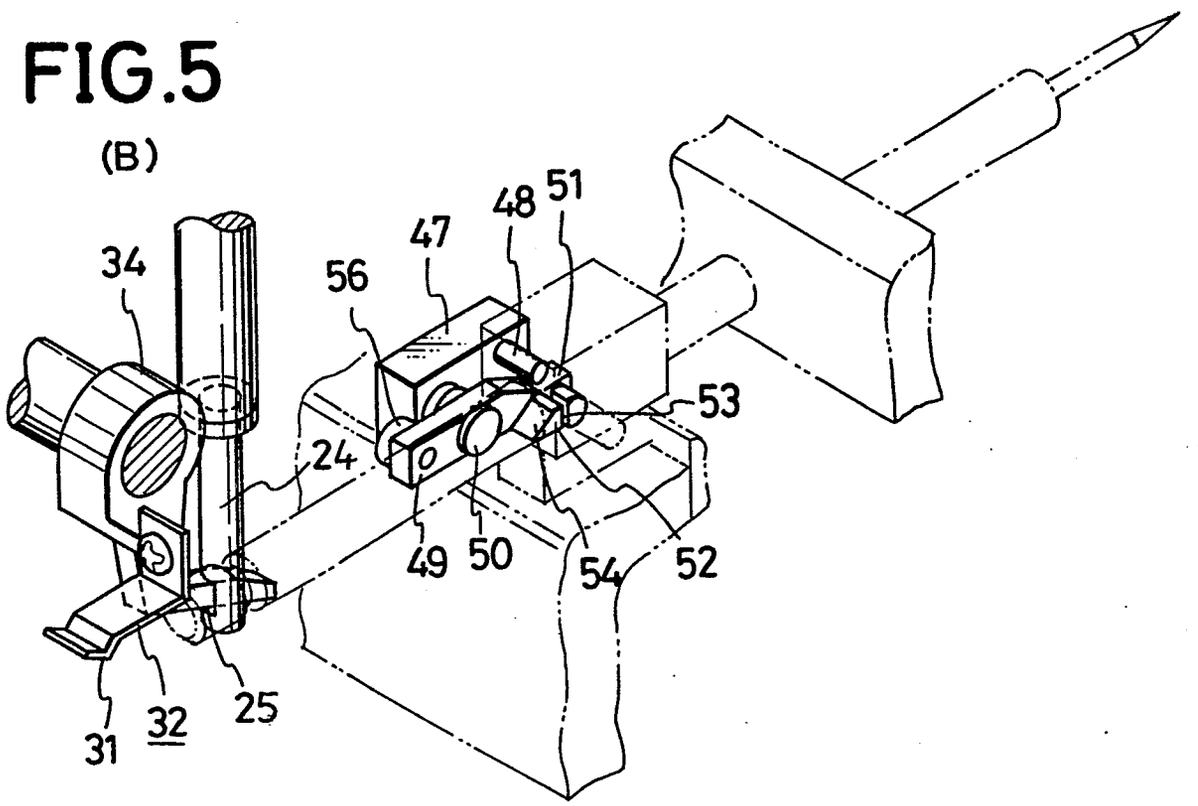
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FIG.5

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